A STUDY OF *SYNGNATHUS SCOVELLI* In FRESH WATERS OF LOUISIANA and SALT WATERS OF MISSISSIPPI

by

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ABSTRACT

A breeding population of *Syngnathus scovelli* was discovered in 1960 in Lake St. John near Ferriday, Louisiana, which is over 300 river miles from the Gulf of Mexico by the shortest possible route. Although *S. scovelli* has been known to be euryhaline, this constitutes the first record of a breeding population in fresh water.

This study encompassed the period from July 1960 through February 1966. During this time *S. scovelli* were maintained for varying periods of time in fresh water aquaria. The longest period of time any one specimen lived in captivity was from 29 September 1960 until 16 November 1962, almost 27 months. The chief limiting factor to the maintenance of *S. scovelli* in fresh water aquaria appears to be a ready supply of live plankton for food.

The breeding process of brackish water specimens was observed and is described. Gestation took 12 days in two males in August and both males bred the day after giving birth to a previous brood.

Young *S. scovelli* measured 12 mm at birth. This is the first report of the length of newly born *S. scovelli* in the literature. A size range of 12-160 mm in length was noted for the species.

A very rapid growth rate has been noted in the young from 12-80 mm, but growth slowed greatly at 80 mm. Three apparent year classes have been postulated among the specimens of *S. scovelli* collected in Lake St. John. These were: 0 (12-80 mm), 1 (80-120 mm), and 2 (120-160 mm). Consecutive monthly data have not been consistent enough to prove this. Failure to collect these data may be due in great measure to the rotenone placed in Lake St. John by the Louisiana Wild Life and Fisheries Commission on 12 October 1961.

The fresh water population from Lake St. John showed less variation in meristic characters than did the fish from Mississippi Sound.

INTRODUCTION

The first of many pipefish, *Syngnathus scovelli* (Plates I and II) was collected by me from fresh water in Lake St. John (Plate III, Figs. 1 and 2) near Ferriday, Louisiana, on 23 July 1960. A cast net, being used in a futile attempt to secure shad for bass bait, was thrown around a bit of naiad *(Najas guadalupensis)*. When the net was shaken out upon the boat seat, the catch yielded a pipefish. As the mesh of the cast net was fairly large (½ inch) and the pipefish small (60 mm long by less that 3 mm in width), this capture was the result of the entanglement of the fish in the naiad.

Lake St. John is an oxbow lake of the Mississippi River which, according to Lambou (1961), was cut off from the Mississippi River by a levee sometime prior to 1879. It is located in Concordia Parish with its extreme northern shore forming the boundary between Concordia and Tensas Parishes. Lambou (1961) states that Lake St. John has a maximum depth of 26 feet, with the majority of the lake ranging from 10-20 feet in depth, a shore line of 17 miles and a surface area of 2,074 acres. Hutchinson (1957) classified lakes as to their origin and described the processes involved in their formation. Lake St. John was formed by fluviatile action and is classified as type 55 of Hutchinson—an oxbow or isolated loop of meanders.

Gunter (1952) states that levee construction along the Mississippi River started in 1717 at New Orleans and was a gradual process up until about 1880. From that time on the rate was accelerated until the nineteen-thirties when the whole system was greatly extended and more or less stabilized following the disastrous flood of 1927.

A map (Fisk, 1944, Consultant's report: Geological Investigation Mississippi River Alluvial Valley Stream Courses. Mississippi River Commission Vicksburg, File No. MRC/258 85H18C), supplied to the writer by Dr. R. R. Priddy of the Gulf Coast Research Laboratory, shows that an old Mississippi River bed crossed the present site of Lake St. John twice in fairly recent geological time, once 2,000 years ago and again about 1,000 years ago. Pipefish could have become established in this area as far back as 1,000 or 2,000 years ago or within recent years. Today they may swim up the Atchafalaya, Red, Black, and Tensas Rivers (Plate III, Fig. 1) and reach the area through streams overflowing in the spring. It has been shown that certain euryhaline marine fishes ascend the Mississippi River system as far as the Black River (Gunter 1938). The pipefish, *S. scovelli*, has been recorded as euryhaline from several sources and it was not too surprising to find a population in Lake St. John. However, the discovery that this was a resident, breeding population was totally unexpected, for *S. scovelli* is marine and was only known heretofore to breed in salt water. The literature on *S. scovelli* has been largely confined to morphological features and range, with few ecological notes.

Several questions arose as a result of the discovery of *S. scovelli* in the inland fresh waters of Louisiana, namely: (1) was this fish representative of the population previously designated as *S. scovelli?* (2) was this population homogenous? (3) did similar populations exist in other oxbow lakes of the Mississippi River? (4) could this fish be maintained in fresh water aquaria? (5) how long had this population existed in Lake St. John? (6) what is the life history of this fish?

REVIEW OF THE LITERATURE

Jordan and Evermann (1896) indicate that *Syngnathus* was first used in the literature in 1738 by Artedi who published *Syngnathus* in reference to *ophidion, acus, typhle,* etc. in Genera. Linnaeus (1758) through publishing this work of Artedi established *Syngnathus* as a valid genus. Thus Myers (1964) is supported in his statement "There is some reason to believe that the somewhat elder Artedi was largely responsible for the younger Linnaeus' ideas and systems of biological classiflication." *Syngnathus scovelli* was originally listed as *Siphostoma fuscum* var. in 1894 by Evermann and Kendall. These same authors published a "Description of a new species of pipefish *Siphostoma scovelli* from Texas" in the Proceedings of the United States National Museum, Vol. XVIII, No. 1043, Pages 113-115 1898 (1896).

PLATE I

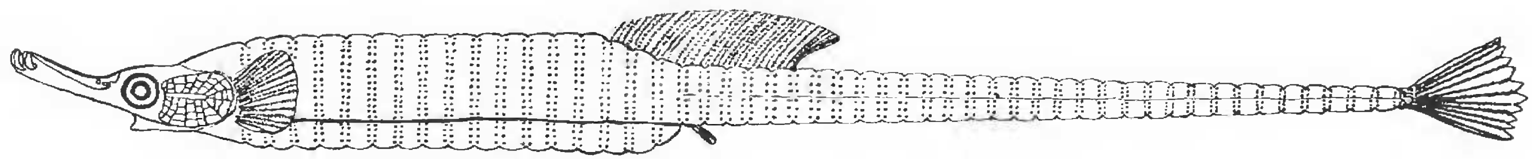


Fig. 1 Female Syngnathus scovelli
(Evermann and Kendall) 1896 Length 147 mm.

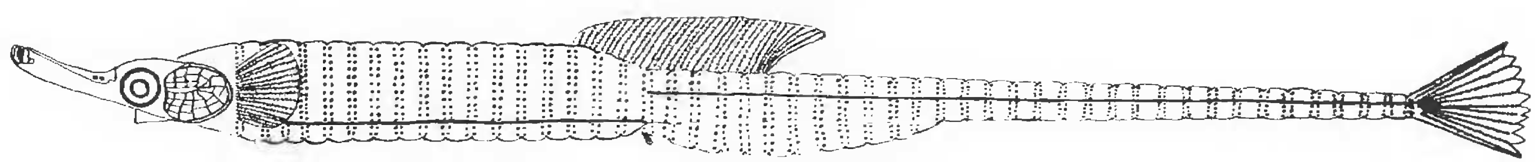


Fig. 2 Male Syngnathus scovelli
(Evermann and Kendall) 1896 Length 147 mm.

PLATE II

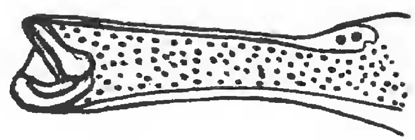


Fig. 1 snout

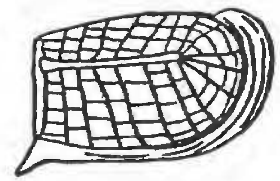


Fig. 2 operculum

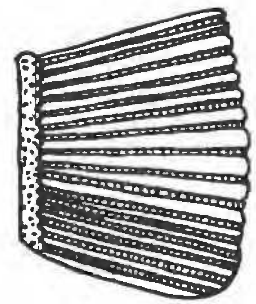


Fig. 3 pectoral fin

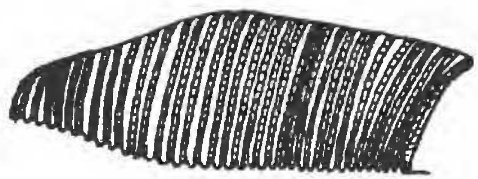


Fig. 4 dorsal fin

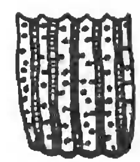


Fig. 5 anal fin

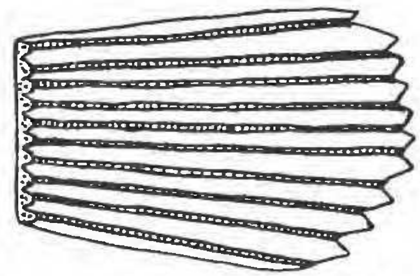


Fig. 6 caudal fin

This reference is basic to the present paper; therefore, it is given in its entirety:

> A re-examination of the specimens of pipefish from Corpus Christi which we referred, with hesitation in an earlier paper, to *Siphostoma fuscum* (Storer), has convinced us that they cannot belong to that species but represent a species hitherto undescribed.
>
> Type—Male and female, No. 47300, U. S. N. M.
>
> Locality—Shamrock Point, Corpus Christi, Texas, where 130 specimens were obtained November 29, 1891, by Messrs. Evermann, Scovell, and Gurley, of the U. S. Fish Commission.
>
> Allied to *Siphostoma affine* (Günther).
>
> Description of female—Head, 7¼; depth 14; snout 2¼; D.34 on 4+4 rings; its height 2 in base, which equals head. Rings 16+32. Nape slightly carinated. Color in alcohol, alternately annulated with light olive brown and dirty white; the dark colors on joints, the white on the bodies of the rings; dark color wider than white on trunk, narrower on caudal portion; white annulations on trunk between lateral and latero-ventral keels indicated by two narrow white lines with narrow black lines on either side and between, these portions of the whitish rings showing as silver bars in life and fresh alcoholic specimens; upper part of opercles dusky; a dark bar extending from the anterior edge of eye to end of snout; ventral keel, throat, lower part of opercles and snout, plain, whitish; dorsal with dark wavy diagonal bars. Other specimens vary in color from somewhat lighter to considerably darker than the above, the darker ones having some white mottling on throat, opercles, and beneath snout. Other females differ in much less depth, lower dorsal fin and in the color which ranges from almost plain olive through forms with reddish mottled appearance to brownish; fewer light-colored annulations and no distinct white or silver bars on sides.
>
> Description of male—Head 7½; depth 22½; snout 2¼; D. 33, on 4+4 rings; its height 2¾ in its base, which equals head. The male differs from the typical female in much less depth, lower dorsal fin, and in the coloration, all of which characters are those of shallow females. There is in the male, as in female, considerable color variation, but there are never any distinct white or silvery marks on the sides. Of the 130 specimens, 114 are females and young, 16 being adult males. Some of these were called by us *Siphostoma fuscum*. in the "Fishes of Texas and the Rio Grande Basin."

Jordan and Evermann (1896) state that:

> *Siphostoma scovelli* (Evermann and Kendall) 1896 was named for Dr. Joseph T. Scovell of Terre Haute, Indiana; that these specimens reached a length of 4½ inches and were common at Corpus Christi and perhaps elsewhere on the Gulf of Mexico. Apparently most of the published references to *S. affine* from the Gulf of Mexico belong to this species, which

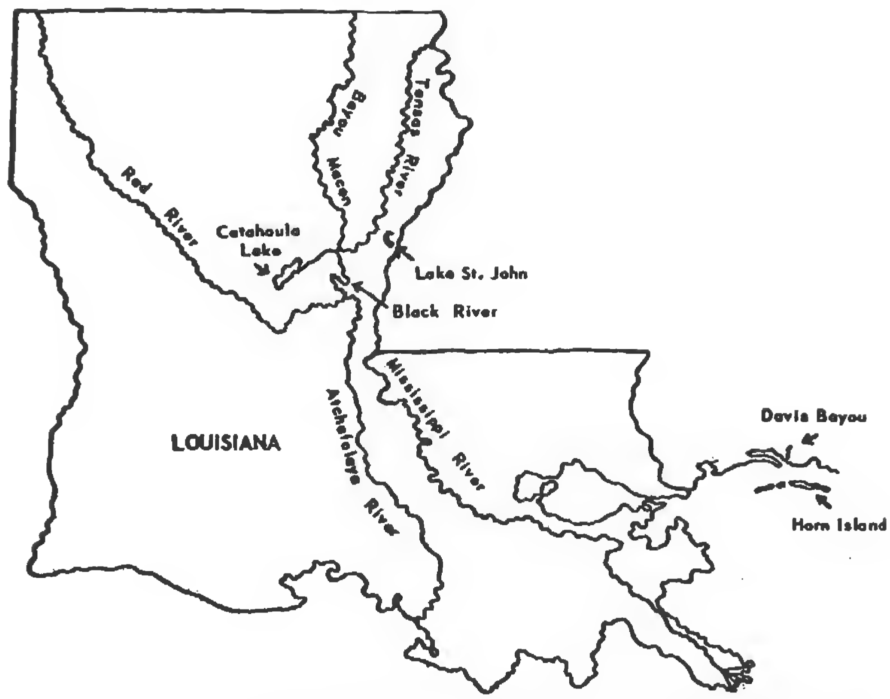


Fig. 1 LOUISIANA AND A PORTION OF THE COAST OF MISSISSIPPI

differs from *S. affine* chiefly in having fewer body rings, in the more posterior position of the dorsal fin and in the fewer dorsal rays.

The aforementioned authors (1896) give the following historic review:

> The genus *Syngnathus* of Linnaeus, originally equivalent to the modern family of Syngnathidae was first subdivided by Rafinesque in 1810. The name *Siphostoma* was given to *S. pelagicus* and its relatives, the *Syngnathus* of late writers, that of *Tiphle* to *S. typhle*, the *Siphostoma* of late writers, while *Syngnathus* was retained for *S. aequoreus* and its relatives, the group now usually called *Nerophis*, the type of *Nerophis* being *Syngnathus ophidion*, L. This arrangement has been adopted here, but it is open to two objections besides the fact that it is contrary to the general usage, which makes *acus* the type of *Syngnathus*, in accordance with Swainson's arrangement. These objections are (1) that Artedi, from whom Linnaeus accepted the genus *Syngnathus*, did not know of the existence of *Syngnathus aequoreus*, and (2) the statement of Linnaeus (which we have been unable to verify), that the type of each of his genera is the "best known European or official species." *Syngnathus acus* would meet this requirement, but not *Syngnathus aequoreus*, which had not then been found in Europe. Should these objections be found valid, *Syngnathus* would take the place of *Siphostoma*, and *Nerophis* that of *Syngnathus*.

Herald (1941) reviewed the *Syngnathus californiensis* Storer complex. This paper is remarkable because of the author's discussion of sexual dimorphism, brood pouch appearance, egg laying and breeding season. Herald found that color had no taxonomic value in pipefish identification and concluded that some of the sub-speciation in the *S. californiensis* complex was of doubtful value.

Herald (1942) published a key to the Atlantic American species of pipefishes including *S. scovelli*.

Gunter (1942) noted that *S. scovelli* was known to inhabit most of peninsular Florida.

Gunter (1945) found *S. scovelli* with eggs in their brood pouches in June, August and November and a male with young in the brood pouch in October off the Texas coast. These ranged from 80-96 mm in length.

Breder (1948) incorrectly attributes *S. scovelli* to Evermann and Marsh 1902. His bibliographical reference to the Bulletin of the United States Fish Commission, Volume XX for 1900, published by the Government Printing Office in 1902 is in error and this work authored by Evermann and Marsh does not even contain a synonym for *S. scovelli*.

Reid (1954) reported conspicuous sexual dimorphism in *S. scovelli*, adult females marked with 15 to 18 vertical bars of silver on the trunk and considerably larger than males. Reid also made some observations on the size range of breeding males.

Gunter (1956) reported four marine syngnathids on the coasts of the western hemisphere which are known to be euryhaline *(Pseudophallus starksi, Syngnathus elcapitanensis, S. fuscus* and *S. scovelli.)* He also noted that Hildebrand reported a breeding population of *Oostethus lineatus* in fresh water; however, *O. lineatus* is not known to exist in pure sea water.

Eddy (1957) states that *S. scovelli* is very long and slender with a prehensile tail by which it clings to vegetation. This statement is incorrect for *S. scovelli* does not have a prehensile tail.

Simmons (1957), while studying the ecology of a hypersaline bay area, found that as salinity increased, the number of species decreased but the number of individuals of each species became greater. Simmons indicated that *S. scovelli* was common in salinities up to 45 o/oo.

Renfro (1960) reported a salinity range of 0.06-38.1 o/oo for *S. scovelli.*

Springer and Woodburn (1960) indicated a relationship between frequency of breeding and size in male *S. scovelli* and noted that breeding of *S. scovelli* took place all year with little change in incidence.

Herald (1961) relates some interesting facts about the mating behavior of *Syngnathus floridae,* the dusky pipefish found in the Gulf of Mexico but does not mention *S. scovelli.*

Herald (1961, personal communication) wrote:

> Although *S. scovelli* survives easily in salt water, no one as yet has kept the species alive in fresh water for more than a few days or at the most, a few weeks. I might mention that some of the best aquarists in the country have stubbed their toes on this one.

Prior to Whatley (1962) there is no mention of a breeding population of *S. scovelli* in fresh water.

Taylor (1966, personal communication) stated that the International Commission on Zoological Nomenclature, Opinion 45 (Smithsonian Institute Publication 2060, p. 101, 1912) tentatively designated *Syngnathus acus* Linnaeus as the type species of *Syngnathus.* In opinion 77 (Smithsonian Institute Publication 2657, p. 37, 1922) *S. acus* Linnaeus was fixed as the type species of *Syngnathus. S. scovelli* has been the correct name since 1912 as confirmed by the Commission in 1922. These opinions validate the objections stated by Jordan and Evermann (1896).

MATERIALS AND METHODS

A. Collecting

Among the numerous devices employed in attempts to capture *S. scovelli* during the period 23 July 1960 to 25 March 1966, were small meshed rectangular dip nets, a variety of minnow seines of varying mesh size, depth and lengths; several rectangular box-like collecting devices of light metal rods covered with alternate layers of fine aluminum screen and hardware cloth; and two types of electrical shocking devices called "electric seines." These latter have been dubbed "the widow makers" by the Louisiana Wild Life and Fisheries Commission crews which use them. This equipment is described in detail by Witt and Campbell (1959). Marine pipefish were taken in seines, small rectangular dip nets, and by trawling. In the grass off Horn Island, the most successful device employed was the rectangular dip net.

Louisiana Wild Life and Fisheries Commission crews made several one-acre rotenone samples for me. The most recent of these, made 21 September 1965, provided 11 *S. scovelli*. This sample was made while I was present and proved the only effective rotenone sample made in Lake St. John as far as the collection of pipefish was concerned.

The most effective collecting device used to collect *S. scovelli* in Lake St. John proved to be a make-shift device pressed into service on 26 July 1960. This was an aquarium cover for a 50 gallon aquarium in the form of a rectangular wooden-framed shallow box 50 inches by 2 inches wide on the sides and 26 inches by 2 inches at the ends with two 26-inch braces spaced equidistant from the ends of the bottom to divide the bottom into three sectors. All wooden pieces were one-quarter inch fir. The bottom was of copper screening covered by one-quarter inch hardware cloth. Two handles (42 inch x 2 inch x 2 inch), which could be readily removed for convenience in transport, were fastened to the sides of this collecting device by long bolts. Two people, wading in water around waist deep, would slide this device along the lake bottom at a fairly sharp angle. When the device became filled with vegetation it was quickly raised to the level of the water surface and fishes trapped in the vegetation were removed by aquarium type nets which the persons operating the device wore around their necks on long cords. These fishes were then placed in plastic bags or buckets for transport. A child's wading ring supporting a plastic bucket full of lake water was tied by a long cord to the waist of one operator of the collecting device and provided a ready container in which pipefish could be kept with a minimum amount of handling. A supply of plastic bags which would hold five gallons of lake water was also carried.

B. Aquarium Studies

Numerous containers were used in attempts to keep *Syngnathus scovelli* alive for study purposes. These ranged from 50-gallon, 26-gallon, 10-gallon and 5-gallon glass aquaria to 25-gallon, 15-gallon, 10-gallon, 5-gallon, and 3-gallon plastic containers. Containers in which the fish were transported had been well washed before they were taken to the lake and were rinsed again in lake water before being used. Five-gallon jugs were filled with lake water each trip. This water was used to replace the water lost by evaporation and sloshing of water from the containers during transport.

Several types of aquatic organisms have been tried as food for *S. scovelli*. Brine shrimp *(Artemia salina)* eggs were hatched and the young brine shrimp fed to the fish. These were not only difficult to hatch in sufficient quantity but were expensive as well. A 5-pound container of eggs purchased for the purpose of feeding these fish had a very low hatching percentage despite trials of a variety of methods for increasing hatching percentage. Mosquito larvae of small size were readily taken by the fish.

A plankton net was used to secure food for *S. scovelli* in the same location where the fish were taken. Plankton was also taken from Bayou DeSiard at Monroe, Louisiana by using the plankton net and a plankton light trap. Dr. A. J. Speece, formerly of Northeast Louisiana State College, now employed by Texas State Women's University of Denton, Texas, constructed a plankton light trap by using several pencil flashlight bulbs attached in series to a car battery. The bulbs, their magnifying tip having been dipped in an indelible blue ink and then allowed to dry, were suspended in a large test tube. This tube was surrounded by a cone of one-quarter inch mesh hardware cloth. A fine meshed cloth bag with a draw string was attached to the bottom of the cone of hardware cloth. Plankton attracted to the yellow light given off by the sides of the bulbs swam into the zone around the bulbs, were repelled by the blue light at the bottom of the bulbs and swam down into the bag. A 24-inch square piece of wood, one-inch thick, formed the float for each trap and the test tube was suspended through a three-inch wide opening bored in the center of the float.

RESULTS

A total of 44 collecting trips were made to Lake St. John from 23 July 1960 until 20 March 1966 resulting in the taking and preservation of 1,137 *S. scovelli* (Plate IV, Graph 2, and Table I).

During this same period other *S. scovelli* were maintained in var ious types of aquaria. One male taken 29 September 1960 survived until 16 November 1962 having lived in a 50-gallon aquarium with a filter of silk cloth under the sand for almost 27 months. Five other specimens taken 12 October 1960 survived until 18 March 1962, a period of 18 months, in a 20-gallon aquarium with an under-the-sand filter of silk. Numerous individual specimens survived from three to seven months each in fresh water containers of various types during this study.

A male taken 13 September 1960 gave birth to 16 offspring in a 5-gallon fresh water aquarium (Whatley 1962). Males with eggs in their brood pouches have been taken from March through October. Collecting trips during the other four months of the year have not produced any pipefish; therefore, the lack of male specimens with eggs in their brood pouches during these months does not necessarily reflect their absence in Lake St. John at those times. None of the young born in fresh water aquaria survived longer than five days.

S. scovelli ranging from 28 to 70 mm in total length were maintained in aquaria for several weeks. These specimens grew at a rapid rate until their length approached 80 mm at which time the growth rate slowed sharply. Indications of three year classes of individuals (0: 12-80-mm, 1: 80-120 mm and 2: 120-160 mm) were present, but consecutive monthly data were not enough to prove this point.

Many of the *S. scovelli* taken from Lake St. John have been found enmeshed in naiad *(Najas guadalupensis)*. When naiad was placed in aquaria with the pipefish, they maintained themselves in it in an almost horizontal position with the tip of the snout being slightly elevated. In this vegetation the pipefish appeared slightly green in color, but they did not approach the vivid colors present at the time they were taken from Lake St. John. Specimens freshly taken from the lake vary greatly in color but their colors are generally bright. Some forms have rich brown backs with darker brown to black rings, intergrading through lighter brown sides with an iridescent golden or metallic green sheen. The belly on some was a creamy white with yellow lateral margins, while others were uniformly light, yellowish brown or grey on the back with very light grey bellies. Evermann and Kendall (1896) described the preserved forms very well with regard to coloration, a description which has been given in the literature review.

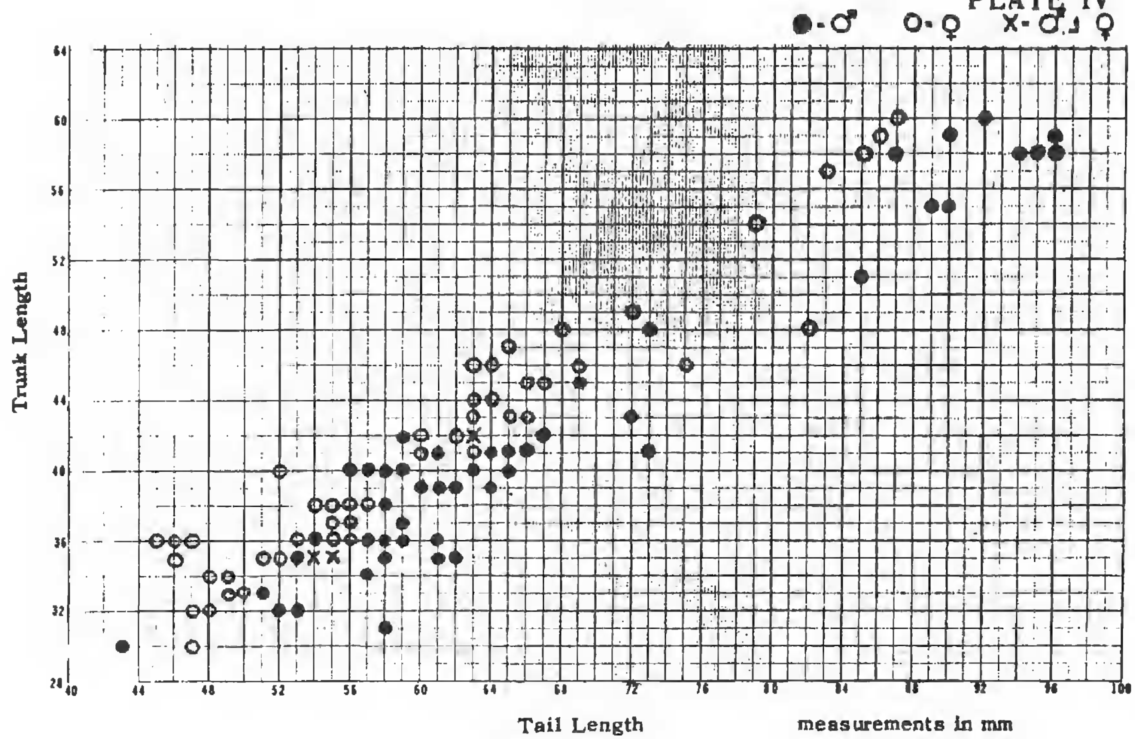
I took *S. scovelli* around several aquatic plants other than the naiad previously listed. Some of these are: (1) water-millet *(Zizaniopsis miliacea)*, which forms a border around most of Lake St. John; (2) bald cypress *(Taxodium distichum)*, which grow at the shore-line, about 50-yards out from shore and about 100 yards out from much of the east shore of the lake, along most of the rest of the shore and in the shallower water area at the extreme northwestern portion of the lake; (3) American lotus *(Nelumbo pentapetala)* which is found in patches 20 to 30 yards out from the east and west shores.

Other aquatics which proved disappointing as pipefish habitat were: (1) coontail *(Ceratophyllum demersum)*, (2) alligator weed *(Altermanthera philoxeroides)*, (3) duckweed *(Lemna minor)*, and (4) willow primrose *(Jussiaea grandiflora* and *J. diffusa)*. The classification of aquatics listed above is according to Muenscher (1944) except for *Z. miliacea* which is according to Fernald (1950).

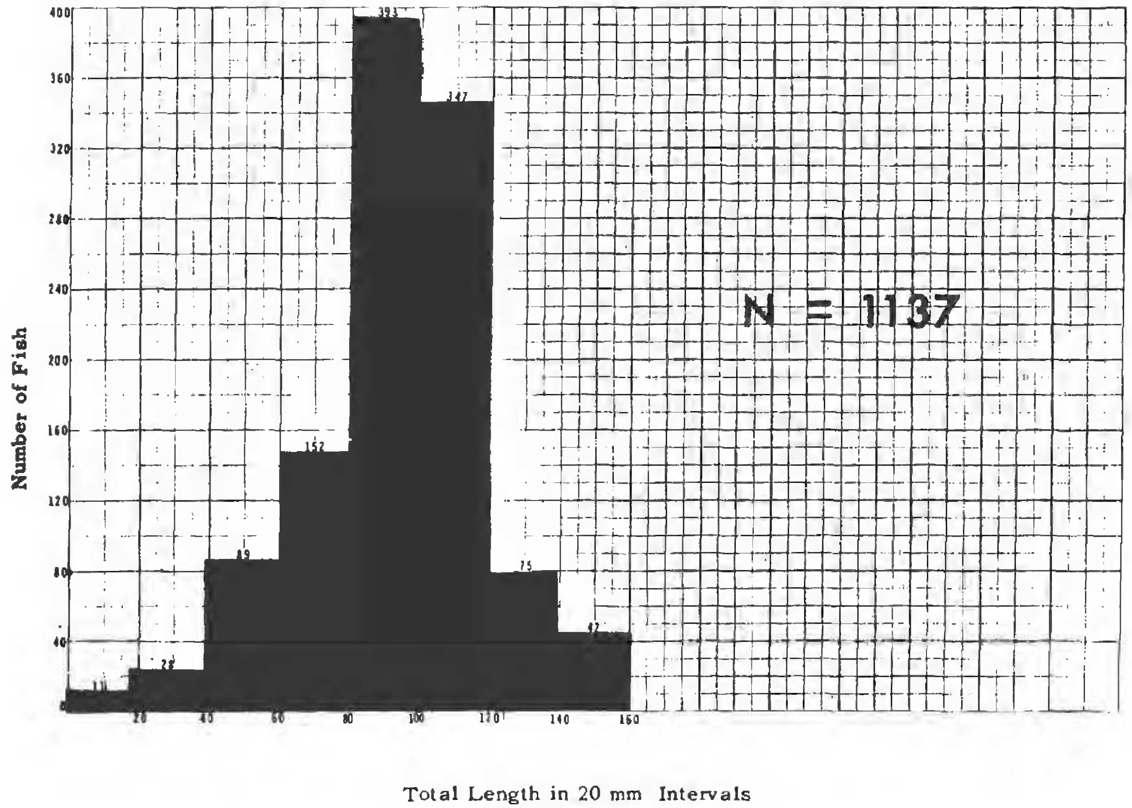
Plankton was plentiful in Lake St. John during the first part of this study. Phytoplankton, rotifers, copepods and ostracods were abundant in plankton samples taken along with pipefish. Plankton organisms in plastic bags of lake water were placed on ice in insulated containers but did not remain alive for a very long period of time. It was necessary to collect plankton nightly at Bayou DeSiard to supplement the plankton taken in the light traps previously mentioned. These fish seem to have an extremly high metabolic rate. They did not stop feeding as long as plankton remained in the tank. Pipefish are tireless hunters and the independent action of their eyes is quite helpful in feeding. Plankton organisms on either side at different levels are spotted quite readily and taken in with quick movements of the snout, up and down, right and left.

Many of the fishes taken in the collecting devices along with pipefish have been found competing with the pipefish for plankton. This is especially true of the young of the year of the various sunfishes, darters, silversides, madtoms, mosquito fish, shad, and the various killifishes in Lake St. John. The gars, bowfin, bass, white crappie, black crappie, and the larger sunfishes are predatory and feed on the plankton feeders. The grass shrimp *(Palaemonetes kadiakensis)* also actively competes for plankton in Lake St. John. This same relation

PLATE IV



GRAPH NO. 1 Scatter graph plotting trunk length against tail length of 50 female and 50 male specimens of Syngnathus scovelli from Lake St. John, Louisiana.



GRAPH NO. 2 Histogram of length frequencies of 1137 specimens of *Syngnathus scovelli* collected in Lake St. John, Louisiana from July 1960 through March 1966.

exists in Davis Bayou and off Horn Island with other species of *Palaemonetes*. Young of the year of many fishes are plankton feeders. These form the base of the food chain and predatory fishes come into the shallows and feed on the plankton feeders.

On 7 August 1961 seven *S. scovelli* in a 10-gallon aquarium were given plankton which had not been strained. This plankton contained *Dugesia tigrina*. Almost immediately a number of these flatworms attached themselves to the gills of three living pipefish whereupon the pipefish began writhing about on the bottom of the tank. It was soon apparent that the pipefish could not dislodge the flatworms, and they were removed from the tank so that the flatworms could be picked off with forceps. The four unharmed pipefish were removed from the tank and suffered no ill effects. Those three specimens to which the flatworms had attached did not recover.

S. scovelli were fairly abundant around the natural springs welling up into the Lake St. John shallows off the east shore near Blackwood Landing in July and August of 1960. The water temperature around these springs averaged 10 F cooler than the surrounding bottom waters and about 20 F cooler than the surface waters in direct sunlight. Optimum temperature for *S. scovelli* appears to range between 72 F and 80 F. Activity greatly slowed down in tanks when temperature of the water rose to 82 F. Very few specimens survived the trip from Lake St. John to Monroe, Louisiana (a distance of around 100 miles) when the water temperature in the fish containers approached 85 F. Plastic bags containing lake water and fish were placed in ice chests in which a small amount of crushed ice had been placed. This lowered the temperature to between 70 F and 80 F and proved to be a successful technique in transporting the fish. The most successful trips with living fish were those made early in the morning or late at night when the daily air temperature was at its lowest point.

Movement of *S. scovelli* from place to place in aquaria is accomplished by joint movement of the pectoral fins and the dorsal fin. In the dorsal fin S-shaped waves of movement progressing along its length are evident when the fish is viewed from above. The fish is not a rapid swimmer but its movements from side to side are deceptively quick.

Most of the 1,137 specimens of *S. scovelli* collected and preserved (Plate IV, Graph 2) were taken prior to 12 October 1961. At that time a Louisiana Wild Life and Fisheries Commission crew under the direction of Mr. Tommy Allen, then employed in the Ferriday, Louisiana office of the Louisiana Wild Life and Fisheries Commission, placed a great deal of rotenone in the lake in an attempt to effect a partial shad *(Dorosoma cepedianum* and *Dorosoma petenense)* kill. This effort did not appear to be very successful as far as shad were concerned, but it seemed to be extremely effective on pipefish and naiad. On 17 October 1961 I waded through a fishy, smelly, decaying mass of organic matter in search of pipefish. No living pipefish were taken at this time nor for some time thereafter. On 22 June 1962, 27 *S. scovelli* were taken, 11 of these being only 18 mm in length. The population is slowly returning. The naiad *(Najas guadalupensis)* has not been plentiful since 12 October 1961. Only scattered sprigs seem to exist over most of the lake. The most recent additions to the collection

TABLE I

Summary of data from collecting trips made to Lake St. John, Louisiana from 23 July 1960 through 20 March 1966.

	Date	Range In Size Of Specimens In Millimeters	Total Number Of Specimens Collected And Preserved On Each Date
1.	23 July 1960	60 -	1
2.	26 July 1960	80 - 155	26
3.	30 July1960	65 - 145	12
4.	11 August 1960	65 - 142	45
5.	14 August 1960	72 - 105	69
6.	26 August 1960	68 - 147	203
7.	13 September 1960	80 - 108	52
8.	15 September 1960	82 - 105	44
9.	29 September 1960	68 - 127	18
10.	12 October 1960	71 - 112	208
11.	18 December 1960	-	none
12.	18 June 1961	65 - 152	12
13.	18 July 1961	24 - 122	92
14.	14 August 1961	77 - 112	74
15.	7 October 1961	44 - 160	77
16.	10 October 1961	60 - 127	127
17.	17 October 1961		none
18.	17 December 1961		none
19.	19 April 1962		none
20.	2 May 1962		none
21.	16 May 1962		none
22.	22 June 1962	18 - 128	27
23.	27 August 1962	47 - 137	14
24.	17 September 1962		none
25.	19 September 1962		none
26.	22 January 1963		none
27.	15 February 1963		none
28.	14 March 1963		none
29.	27 April 1963		none
30.	30 May 1963	72 - 118	6
31.	13 August 1963	86 - 115	11
32.	15 September 1963		none
33.	2 September 1964		none
34.	9 September 1964		none
35.	21 September 1965	89 - 119	11
36.	28 September 1965		none
37.	12 October 1965		none
38.	19 October 1965		none
39.	17 December 1965		none
40.	29 January 1966		none
41.	12 February 1966		none
42.	19 February 1966		none
43.	18 March 1966	98 - 142	4
44.	20 March 1966	110 - 157	4
		Total	1,137

are four specimens taken on 20 March 1966. Approximately 356 hurs were spent collecting at Lake St. John. Much of this collecting effort was unsuccessful after rotenone was placed in the lake 12 October 1961.

During the period July 1960 to March 1966, 27 collecting trips were made to other oxbow lakes of the Mississippi River relatively near Lake St. John. Allocation of these trips was as follows: Lake Bruin was visited 19 times; Lake Concordia, 6 times, and Lake St. Joseph, 2 times. I did not find any pipeflsh in any of these other lakes; however, nine *S. scovelli* have been given to me by other persons who collected them in Lake Bruin. This is the only lake near Lake St. John known to contain pipefish at this time. Approximately 162 hours were spent in collecting attempts in lakes other than Lake St. John.

Mr. C. E. Dawson of the Gulf Coast Research Laboratory examined several of 27 specimens of pipefish taken to the Gulf Coast Research Laboratory in August 1960 and identified the specimens as representative of the population *S. scovelli*. I have seen more than 1,200 specimens from Lake St. John since the first one was found on 23 July 1960 and my collection has recently been carefully checked by Dr. Neil Douglas of Northeast Louisiana State College. A check of 500 specimens preserved reveals a dorsal fin ray count of 35, a pectoral fin ray count of 16, a caudal fin ray count of 10 and an anal fin ray count of five. This population appears to be extremely homogenous throughout. Table I does not reveal any monthly variation in size which is striking. Apparently this population breeds practically every month in the year and failure to collect a greater size range of individuals each time could very well be due to sampling methods employed and to poisoning of the lake.

A. Observations on *S. scovelli* from Mississippi Coastal Waters

In the summer of 1964 and 1965 I collected *S. scovelli* specimens from Davis Bayou near Ocean Springs, Mississippi, and off Horn Island which is off the coast of Mississippi (Plate III, Figs. 1, 3 and 4). These were compared with *S. scovelli* from Lake St. John and the nine specimens from Lake Bruin. No differences could be detected which would indicate that those fish in Lake St. John should be placed in a different species.

S. scovelli were maintained alive in 3-gallon plastic buckets at the Gulf Coast Research Laboratory in June, July, and August of 1964 and in July and August of 1965. In 1964 a number of these fish were transported to Monroe, Louisiana, and some of these were kept alive until March of 1965.

On three occasions, twice in August of 1964 and once in July of 1965, cannibalism was observed in male *S. scovelli* which had given birth to offspring and were eating them almost as rapidly as they were born. In all three cases the males were alone in 3-gallon plastic buckets. Two of these males were preserved after they had eaten around 16 young pipefish each.

On 6 August 1964, a male *S. scovelli* from the vicinity of Horn

TABLE II

Species of fishes other than *Syngnathus scovelli* taken in Lake St. John from 23 July 1960 through 25 March 1966.

Family	Occurrence
1. Lepisosteidae	
Lepisosteus oculatus	common
Lepisosteus osseus	common
Lepisosteus platostomus	common
Lepisosteus spatula	rare
2. Amiidae	
Amia calva	common
3. Clupeidae	
Dorosoma cepedianum	common
Dorosoma petenense	common
4. Cyprinidae	
Cyprinus carpio	common
Notemigonus crysoleucas	common
Notropis maculatus	common
Opsopoeodus emiliae	common
Pimephales vigilax	common
5. Catostomidae	
Erimyzon sucetta	rare
Ictiobus cyprinellus	rare
Ictiobus niger	rare
6. Ictaluridae	
Ictalurus melas	common
Ictalurus natalis	common
Ictalurus punctatus	rare
Noturus gyrinus	common
7. Cyprinodontidae	
Fundulus chrysotus	common
Fundulus notatus	common
Fundulus notti	common
Fundulus olivaceus	common
8. Poecilidae	
Gambusia affinis	common
9. Aphredoderidae	
Aphredoderus sayanus	rare
10. Serranidae	
Roccus mississippiensis	rare
11. Centrarchidae	
Centrarchus macropterus	rare
Chaenobryttus gulosus	common
Elassoma zonatum	rare
Lepomis cyanellus	common
Lepomis humilis	rare
Lepomis macrochirus	common
Lepomis microlophus	common
Lepomis punctatus	common
Lepomis symmetricus	rare
Micropterus salmoides	common
Pomoxis annularis	common
Pomoxis nigromaculatus	common
12. Percidae	
Etheostoma barratti	rare
Etheostoma chlorosomum	rare
Etheostoma proeliare	rare
13. Scianeidae	
Aplodinotus grunniens	rare
14. Atherinidae	
Labidesthes sicculus	common
Menidia audens	rare

Island was placed in a 3-gallon plastic bucket with a female *S. scovelli* from the mouth of Davis Bayou. This male had given birth to 16 offspring on 5 August 1964, and these offspring had been left in a bucket to themselves. At 1815 on the evening of 6 August 1964 the female was observed coming to the surface of the bucket and violently shaking her head from side to side. After about 20 minutes the male swam to the surface and joined the female. Their bodies were erect in the water, forming S-shaped curves. There was a much closer resemblance to the sea horse body form than I would have believed possible. Dorsal fins of both fish were erect and flaring. After swimming around each other and briefly twining bodies for some 10 to 15 seconds, the male approached the female from the rear, (her ovipositor was apparent all of the time), placed his tail around hers and the pair spun around together in the center of the bucket for a very brief interval, approximately 3 to 5 seconds. During this period the female's ovipositor was placed in the brood pouch of the male. This behavior was repeated a second time at 1830. After this the pair was observed until 1930 and no further mating behavior occurred. The male was taken from the container and it was found that his brood pouch was filled with eggs. This indicates either that oviposition is very rapid or that only the end of the mating period was observed. The male was placed in a separate container, and on 18 August 1964 produced 32 young pipefish. He was placed in the container with the same female with which he had previously mated on the night of 18 August 1964. At 0600, 19 August 1964, his brood pouch was found to be filled with eggs again. The young were born on 30 August 1964. Incubation of the eggs in the brood pouch is apparently dependent upon the temperature. Some pipefish collected with eggs in their brood pouches have taken as long as 16 days to have their young.

Young pipefish were given plankton taken by plankton net from the boat slip at Gulf Coast Research Laboratory. This plankton was strained through cheese cloth which had been folded four times. Their rate of growth was extremely rapid, especially the initial growth. From 27 June 1964 until 7 July 1964, their increase in length was from 12 mm at birth to 28 mm in less than two weeks time. As in the fresh water specimens, the rate of growth seems extremely rapid at first. From 27 June 1964 until 18 September 1964, three specimens grew from 12 mm to 60 mm. These three specimens died on 29 September 1964 and were preserved at that time. This represents a 5-fold increase in length in a period of a little more than three months.

S. scovelli, whether they are taken in a fresh water lake (Lake St. John), a brackish water environment (Davis Bayou), or a marine habitat (off Horn Island) appear to be gregarious animals until the brood pouch of the male is filled with eggs. In all three of the locations mentioned, males with eggs were not uncommonly taken by themselves in seine hauls. Pipefish placed in aquaria assemble in one end of the aquarium. On several occasions males with eggs in the brood pouch moved away from the group to the other end of the tank. These were removed and isolated in tanks where the males with eggs assembled in groups. This gregarious behavior apparently is not controlled entirely by feeding. Even when no apparent food

TABLE III

Species of fishes other than *Syngnathus scovelli* collected from Davis Bayou near the Gulf Coast Research Laboratory at Ocean Springs, Mississippi during the summer of 1964 and the Summer of 1965.

Family	Occurrence
1. Dasyatidae	
Dasyatis sabina	rare
2. Lepisosteidae	
Lepisosteus oculatus	common
Lepisosteus platostomus	common
3. Clupeidae	
Brevoortia patronus	common
Dorosoma cepedianum	rare
Dorosoma petenense	rare
4. Engraulidae	
Anchoa hepsetus	common
Anchoa mitchilli	rare
5. Synodontidae	
Synodus foetens	common
6. Ariidae	
Galeichthys felis	common
7. Anguillidae	
Anguilla rostrata	rare
8. Ophichthidae	
Ahlia egmontis	common
Myrophis punctatus	common
9. Cyprinodontidae	
Adinia xenica	rare
Cyprinodon variegatus	common
Fundulus grandis	common
Fundulus jenkinsi	rare
Fundulus similis	common
Lucania parva	rare
10. Poeciliidae	
Gambusia affinis	common
Mollienesia latipinna	common
11. Syngnathidae	
Syngnathus louisianae	rare
12. Centrarchidae	
Lepomis macrochirus	common
Lepomis cyanellus	rare
Micropterus salmoides	common
13. Carangidae	
Chloroscombrus chrysurus	rare
Oligoplites saurus	common
14. Pomadasyidae	
Orthopristis chrysopterus	common
15. Sciaenidae	
Bairdiella chrysurus	common
Cynoscion arenarius	common
Cynoscion nebulosus	rare
Leiostomus xanthurus	common
Menticirrhus americanus	rare
Menticirrhus focaliger	common
Micropogon undulatus	common
Sciaenops ocellata	common
16. Sparidae	
Lagodon rhomboides	common
17. Gobiidae	
Gobionellus schufeldti	rare
18. Blenniidae	
Chasmodes saburrae	rare
Hypsoblennius ionthas	rare
19. Mugilidae	
Mugil cephalus	common
Mugil curema	common
20. Atherinidae	
Membras martinica vagrans	common
Menidia beryllina	common
21. Bothidae	
Citharichthys spilopterus	common
Etropus crossotus	rare
Paralichthys albigutta	rare
Paralichthys lethostigma	common
22. Soleidae	
Trinectes maculatus	common
23. Cynoglossidae	
Symphurus plagiusa	common
24. Batrachoididae	
Opsanus beta	common

is present in aquaria, and no apparent feeding activity is evident, pipefish appear to remain in groups. The salinity range reported for *S. scovelli* is a wide one. Renfro (1960) gives a range of 0.06-38.1 o/oo for the species while Simmons (1957) indicated that *S. scovelli* was common in salinities up to 45 o/oo.

B. Associated Fishes in Fresh Water

Lake St. John collections produced 45 species of fishes other than *S. scovelli* representing 14 families (Table II). Lambou (1961) lists 29 species of fishes from oxbow lakes of the Mississippi River (these include Lake St. John); however, Lambou's listing—mostly minnows *(Cyprinidae)* and other small fishes included most of the other species listed in this paper. Lambou lists *Strongylura marina* as one of his 29 species but does not give the lake in which it was taken or its length. Dr. William R. Taylor, associate curator, Division of Fishes, Smithsonian Institution, United States National Museum, by means of a personal communication has given me permission to use his field notes made while employed in the Monroe, Louisiana, office of the Louisiana Wild Life and Fisheries Commission. These notes reveal that the specimen *S. marina* listed above was taken at False River (one of the oxbow lakes in Lambou's paper) on 25 May 1955 and that this fish was an adult specimen 485 mm in length.

C. Associated Fishes in the Salt Waters of Mississippi

Davis Bayou yielded 51 species of fishes other than *S. scovelli* representing 24 families (Table III). Davis Bayou is a brackish water environment.

Horn Island inlets, ponds and the waters offshore on the Mississippi Sound side are represented by 102 species of fishes from 47 different families (Table IV). Richmond (1962) lists 61 fishes from 32 families from the Horn Island area. My notations, rare or common, in the three tables listed above relate only to my collection of specimens and are not intended to reflect general scarcity or abundance.

The number of species of fishes and the number of families in Table II and Table IV appear to represent a fair sampling of the fish fauna of Lake St. John and the Horn Island area when compared with the publications of Lambou (1961) and Richmond (1962).

D. Sexual Dimorphism

Fully mature female *S. scovelli* have comparatively longer trunks and shorter tails than fully mature male *S. scovelli*. This observation led to an attempt to correlate these factors with regard to the sexes. Fifty females and 50 males were selected from the population of 1,137 preserved specimens. Millimeter measurements were used. A ratio was established by dividing trunk length into tail length and the results were plotted on a scatter diagram graph (Plate IV, Graph 1). The results of the analysis of these data are given in Table V. These data were significant at the 95% level. The selection of specimens was necessary to establish 50 different measurements of each sex. This selection should be taken into consideration when evaluating the data. Mature females showed considerable variation in the ratio of trunk to tail length. A variation of 1.45 in females to 1.62 in males at the high extreme of body length in millimeters was shown.

Herald (1942) gives the following criteria for counts and measurements on pipefishes: (1) all fin rays are counted, (2) the first trunk ring is the ring bearing the pectoral fins, and the last is that bearing the anus, (3) the hypural ring is not included in the tail ring count, (4) the head measurement is taken from the most anterior part of the fish, with the mouth firmly closed, to the posterior end of the opercular bone (care must be exercised in determining this latter point, and often microscopic examination is required), and (5) the snout is measured from the tip to the posterior end of the preorbital bone.

With the above points in mind, some final points concerning the population of *S. scovelli* (Plate I) in Lake St. John are listed: (1) snout-in-head 2.0 to 2.55, (2) trunk segments 17, (3) caudal segments 30-32, (4) dorsal fin rays 35, (5) dorsal fin covering 3 trunk segments and 5 tail segments, (6) brood pouch covering 11-13 tail segments (generally 12), (7) pectoral rays 16, (8) anal rays 5, (9) caudal rays 10. Adult male and female specimens are readily distinguishable from each other. The "V" bellied females have comparatively deeper trunks and shorter tails. The males are more flat bellied, have more slender trunks and longer tails (Plate I, Figs. 1 and 2, Plate II, Figs. 1, 2, 3, 4, 5 and 6). Forms ranging from 80 mm to 115 mm are frequently hard to distinguish with regard to sex and not infrequently dissection of the pipefish in question is required.

The original description of Evermann and Kendall in 1896 listed 16 trunk segments for *Siphostoma scovelli*. Herald's criteria are responsible for the discrepancy in number of trunk segments, not a variation in the animals. The marine and brackish water *S. scovelli* examined constitute a more heterogenous population with regard to meristic characters than the fresh water population in that dorsal fin ray counts vary from 29-35, and pectoral fin rays range from 14 to 16 in the marine species. A statistical analysis of the dorsal fin ray counts of 81 marine *S. scovelli* from the vicinity of Horn Island, Mississippi, compared with the dorsal fin ray counts of 500 fresh water *S. scovelli* from Lake St. John, Louisiana, is given in Table VI.

The eggs in the brood pouch of *S. scovelli* are arranged in two rows and v[illegible] 16 to 64. Common litter size noted was 16. This may b[illegible] [illegible]alism and more fish may be born but a number ma[illegible]

SUMMARY AND CONCLUSIONS

More than 1,200 specimens of *S. scovelli* have been taken from Lake St. John in inland Louisiana. This population is strikingly homogeneous with regard to ring and fin ray counts and probably has not existed in Lake St. John for much over 1,000 years. Herre (1927), working with gobies in the Philippine Islands and the China Sea, found that isolation of these fishes for 10,000 years produced 77 genera and 173 species. The small variation in the *S. scovelli* population in Lake St. John would seem to indicate the establishment of a fairly

TABLE IV

Species of fishes other than *Syngnathus scovelli* taken in ponds and inlets on Horn Island and from offshore on the Mississippi Sound side off Horn Island during the Summer of 1964 and the Summer of 1965.

Family	Occurrence
1. Caracharhinidae	
Scoliodon terraenovae	rare
2. Torpedinidae	
Narcine brasiliensis	rare
3. Dasyatidae	
Dasyatis americana	rare
Dasyatis sabina	common
Dasyatis sayi	common
Gymnura micrura	rare
4. Elopidae	
Elops saurus	common
5. Clupeidae	
Brevoortia patronus	common
Harengula pensacolae	common
Opisthonema oglinum	rare
6. Engraulidae	
Anchoa hepsetus	common
Anchoa mitchilli diaphana	commo
7. Synodontidae	
Synodus foetens	common
8. Ariidae	
Bagre marina	rare
Galeichthys felis	common
9. Ophichthidae	
Ahlia egmontis	common
Myrophis punctatus	common
Ophichthus gomesi	rare
10. Belonidae	
Strongylura marina	common
11. Hemiramphidae	
Hyporhamphus unifasciatus	rare
12. Cyprinodontidae	
Adinia xenica	rare
Cyprinodon variegatus	common
Fundulus grandis	common
Fundulus similis	common
Lucania parva	rare
13. Poeciliidae	
Gambusia affinis	common
Mollienesia latipinna	common
14. Gadidae	
Urophycis floridanus	common
15. Syngnathidae	
Hippocampus erectus	rare
Hippocampus zosterae	common
Syngnathus floridae	rare
Syngnathus louisianae	common
16. Serranidae	
Centropristes philadelphicus	rare
17. Lobotidae	
Lobotes surinamensis	rare
18. Lutjanidae	
Lutjanus griseus	rare
19. Rachycentridae	
Rachycentron canadum	rare
20. Carangidae	
Caranx bartholomaei	rare
Caranx crysos	common
Caranx latus	rare
Chloroscombrus chrysurus	common
Oligoplites saurus	common
Selene vomer	rare
Trachinotus carolinus	common
Trachurus lathami	common
Vomer setapinnis	rare
21. Gerridae	
Eucinostomus argenteus	rare
Eucinostomus gula	rare
22. Pomadasyidae	
Orthopristis chrysopterus	common
23. Sciaenidae	
Bairdiella chrysura	rare
Cynoscion arenarius	common
Cynoscion nebulosus	common
Equetus acuminatus	rare
Larimus fasciatus	rare
Leiostomus xanthurus	common
Menticirrhus americanus	rare
Menticirrhus focaliger	common
Menticirrhus littoralis	common
Micropogon undulatus	common
Pogonias cromis	common
Sciaenops ocellata	common
Stellifer lanceolatus	rare

TABLE IV

(Continued)

Family	Occurrence	Family	Occurrence
24. Sparidae		36. Atherinidae	
Archosargus probatocephalus	common	*Membras martinica vagrans*	common
Lagodon rhomboides	common	*Menidia beryllina*	common
Stenotomus caprinus	rare	37. Polynemidae	
25. Ephippidae		*Polydactylus octonemus*	common
Chaetodipterus faber	common	38. Bothidae	
26. Trichiuridae		*Ancylopsetta quadrocellata*	rare
Trichiurus lepturus	common	*Citharichthys spilopterus*	common
27. Scombridae		*Etropus crossotus*	rare
Scomberomorus cavalla	rare	*Paralichthys albigutta*	common
Scomberomorus maculatus	common	*Paralichthys lethostigma*	common
28. Gobiidae		39. Soleidae	
Gobionellus boleosoma	rare	*Trinectes maculatus*	common
Gobionellus hastatus	common	40. Cynoglossidae	
29. Triglidae		*Symphurus plagiusa*	common
Prionotus evolans	rare	41. Gobiesocidae	
Prionotus rubio	common	*Gobiesox strumosus*	common
Prionotus scitulus latifrons	rare	42. Balistidae	
30. Uranoscopidae		*Alutera schoepfi*	rare
Astroscopus y-graecum	rare	43. Ostraciidae	
31. Dactyloscopidae		*Lactophrys quadricornis*	common
Dactyloscopus tridigitatus	rare	44. Tetraodontidae	
32. Blenniidae		*Lagocephalus laevigatus*	common
Chasmodes saburrae	rare	*Sphaeroides nephelus*	common
Hypsoblennius ionthas	rare	45. Diodontidae	
33. Ophidiidae		*Chilomycterus schoepfi*	common
Rissola marginata	rare	46. Batrachoididae	
34. Stromateidae		*Opsanus beta*	common
Peprilus paru	rare	47. Antennariidae	
Poronotus triacanthus	common	*Antennarius radiosus*	rare
35. Mugilidae		*Histrio histrio*	rare
Mugil cephalus	common		
Mugil curema	common		

TABLE V

Statistical analysis of tail length to trunk ratio in female and male *Syngnathus scovelli.*

Female				Male			
FISH NO.	TRUNK LENGTH	TAIL LENGTH	RATIO	FISH NO.	TRUNK LENGTH	TAIL LENGTH	RATIO
1.	30	47	1.56	1.	30	43	1.43
2.	32	47	1.46	2.	33	58	1.75
3.	32	48	1.50	3.	32	52	1.62
4.	33	49	1.48	4.	32	53	1.65
5.	33	50	1.51	5.	33	51	1.53
6.	34	48	1.41	6.	34	57	1.67
7.	34	49	1.44	7.	35	53	1.51
8.	35	46	1.31	8.	35	54	1.54
9.	35	51	1.45	9.	35	55	1.57
10.	35	52	1.48	10.	35	58	1.65
11.	35	54	1.54	11.	35	61	1.74
12.	35	55	1.57	12.	35	62	1.77
13.	36	45	1.25	13.	36	54	1.50
14.	36	46	1.27	14.	36	57	1.58
15.	36	47	1.30	15.	36	58	1.61
16.	36	53	1.47	16.	36	59	1.63
17.	36	55	1.52	17.	36	61	1.69
18.	36	56	1.55	18.	37	59	1.59
19.	37	55	1.48	19.	38	58	1.52
20.	37	56	1.51	20.	39	60	1.53
21.	38	54	1.42	21.	39	61	1.56
22.	38	55	1.44	22.	39	62	1.58
23.	38	56	1.47	23.	39	64	1.64
24.	38	57	1.50	24.	40	56	1.40
25.	40	52	1.30	25.	40	57	1.42
26.	41	60	1.46	26.	40	58	1.45
27.	41	63	1.53	27.	40	59	1.47
28.	42	60	1.42	28.	40	63	1.57
29.	42	62	1.47	29.	40	65	1.62
30.	42	63	1.50	30.	41	61	1.48
31.	43	63	1.46	31.	41	64	1.56
32.	43	65	1.51	32.	41	65	1.58
33.	43	66	1.53	33.	41	66	1.60
34.	44	63	1.43	34.	41	73	1.78
35.	44	64	1.45	35.	42	59	1.40
36.	45	65	1.44	36.	42	63	1.50
37.	45	66	1.46	37.	42	67	1.59
38.	46	63	1.36	38.	43	72	1.67
39.	46	64	1.39	39.	45	69	1.53
40.	46	69	1.50	40.	48	73	1.52
41.	46	74	1.60	41.	51	85	1.66
42.	47	65	1.38	42.	55	89	1.61
43.	48	68	1.41	43.	55	90	1.63
44.	48	82	1.70	44.	57	87	1.52
45.	49	72	1.46	45.	58	94	1.62

TABLE V

(Continued)

Female				Male			
FISH NO.	TRUNK LENGTH	TAIL LENGTH	RATIO	FISH NO.	TRUNK LENGTH	TAIL LENGTH	RATIO
46.	54	79	1.46	46.	58	95	1.63
47.	57	83	1.45	47.	58	96	1.65
48.	58	85	1.46	48.	59	90	1.52
49.	59	86	1.45	49.	59	96	1.62
50.	60	87	1.45	50.	60	92	1.53

100 selected specimens—50 males plus 50 females
All specimens listed above taken from Lake St. John, Louisiana
All measurements are in millimeters

Females				Males			
X	X^2	X	X^2	X	X^2	X	X^2
1.56	2.4336	1.46	2.1316	1.43	2.0449	1.45	2.1025
1.46	2.1316	1.53	2.3409	1.75	3.0625	1.47	2.1609
1.50	2.2500	1.42	2.0164	1.62	2.6244	1.57	2.4649
1.48	2.1904	1.47	2.1609	1.65	2.7225	1.62	2.6244
1.51	2.2801	1.50	2.2500	1.54	2.3716	1.48	2.1904
1.41	1.9881	1.46	2.1316	1.67	2.7889	1.56	2.4336
1.44	2.0736	1.51	2.2801	1.51	2.2801	1.58	2.4964
1.31	1.7161	1.53	2.3409	1.54	2.3716	1.60	2.5600
1.45	2.0125	1.43	2.0449	1.57	2.4949	1.78	3.1684
1.48	2.1904	1.45	2.1025	1.65	2.7225	1.40	1.9600
1.54	2.3716	1.44	2.0736	1.74	3.0276	1.50	2.2500
1.57	2.4649	1.46	2.1316	1.77	3.1329	1.59	2.5281
1.25	1.5625	1.36	1.8496	1.50	2.2500	1.67	2.7889
1.27	1.6129	1.39	1.9321	1.58	2.4964	1.53	2.3409
1.30	1.6900	1.50	2.2500	1.61	2.5921	1.52	2.3104
1.47	2.1609	1.60	2.5600	1.63	2.6569	1.66	2.7556
1.52	2.3104	1.38	1.9044	1.69	2.8561	1.61	2.5921
1.55	2.4025	1.41	1.9881	1.59	2.5281	1.63	2.6569
1.48	2.1904	1.70	2.8900	1.52	2.3104	1.52	2.3104
1.51	2.2801	1.46	2.1316	1.53	2.3409	1.62	2.6244
1.42	2.0164	1.46	2.1316	1.56	2.4336	1.63	2.6569
1.44	2.0736	1.45	2.1025	1.58	2.4964	1.65	2.7225
1.47	2.1609	1.46	2.1316	1.64	2.6896	1.52	2.3104
1.50	2.2500	1.45	2.1025	1.40	1.9600	1.62	2.6234
1.30	1.6900	1.45	2.1025	1.42	2.0164	1.53	2.3409
	EX	=	72.92	EX	=	79.00	
	EX^2	=	106.6750	EX^2	=	125.2156	
	$E(X)^2/50$	=	106.3465	$E(X)^2/50$	=	124.8200	
	$\overline{X}$	=	1.4584	$\overline{E}$	=	1.5800	

TABLE V

(Continued)

$$S^2_{\bar{x}} = \frac{125.2156 - 124.8200 + 106.6750 - 106.3465}{50 + 50 - 2}$$

$$S^2_{\bar{x}} = \frac{0.7241}{98} = 0.074$$

$$S^2_{\bar{x}_1 - \bar{x}_2} = .0074\ (1/50 + 1/50) = .0074 \times \frac{2}{50} = \frac{.0148}{50} = 0.000296$$

$$S_{\bar{x}_1 - \bar{x}_2} = \sqrt{1.000296} = 0.0172$$

$$T = \frac{1.5800 - 1.4584}{0.0172} = \frac{0.1216}{0.0172} = 7.06$$

T_c 98 df =

T_c 60 df = 2.000

T_c 120 df = 1.980

T of 7106 is greater than T_c 60 df 2.000 T_c 120 df 1.980. Therefore trunk length ratio of males over females is significant at the 95% level.

The procedure used here is that of Steele and Torrie (1960).

TABLE VI

Statistical analysis of fin ray count of 81 *Syngnathus scovelli* specimens from vicinity of Horn Island, Mississippi compared to fin ray counts of 500 *Syngnathus scovelli* from Lake St. John, Louisiana.

Dorsal Fin Ray Count

1.	29	21.	31	41.	32	61.	34
2.	29	22.	31	42.	32	62.	34
3.	29	23.	31	43.	32	63.	34
4.	29	24.	31	44.	32	64.	34
5.	29	25.	31	45.	32	65.	34
5.	29	25.	31	45.	32	65.	34
6.	29	26.	31	46.	32	66.	34
7.	29	27.	31	47.	32	67.	34
8.	29	28.	31	48.	33	68.	34
9.	29	29.	31	49.	33	69.	34
10.	29	30.	31	50.	33	70.	34
11.	31	31.	32	51.	33	71.	34
12.	31	32.	32	52	33	72.	34
13.	31	33.	32	53.	33	73.	35
14.	31	34.	32	54.	33	74.	35
15.	31	35.	32	55.	34	75.	35
16.	31	36.	32	56.	34	76.	35
17.	31	37.	32	57.	34	77.	35
18.	31	38.	32	58.	34	78.	35
19.	31	39.	32	59.	34	79.	35
20.	31	40.	32	60.	34	80.	35
						81.	35

29 — 10
31 — 20
32 — 17
33 — 7
34 — 18
35 — 9

				Total
N	=	81	500	581
EX	=	2,612	17,500	20,112
EX^2	=	84,494	612,500	696,994
$\frac{(EX)^2}{N}$	=	84,228.938	612,500	696,200.592
X	=	32.247	35.00	34.621

TABLE VI

(Continued)

$$S_b^2 = \frac{84{,}228.938 + 612{,}500.000 - 696{,}200.592}{1}$$

$Sb^2 = 528.346$

$$S_w^2 = \frac{84{,}494 + 612{,}500 - 696{,}728.938}{579}$$

$S_w^2 = 0.458$

$$F = \frac{528.346}{0.458} = 1160.4$$

Crit F ($\underset{c}{\_}$ 80 & 499 df) = 1.24

@ 95% level

TABLE VII

Summary of data on *Syngnathus scovelli* taken from Mississippi Sound side of Horn Island on 16 June 1964.

	TOTAL LENGTH IN MILLIMETERS	SEX	DORSAL FIN RAY COUNT	PECTORAL FIN RAY COUNT
1.	82	male +	31	16
2.	84	male +	32	16
3.	104	male +	29	14
4.	100	male —	32	16
5.	78	male +	34	16
6.	76	male +	32	16
7.	89	male +	29	16
8.	84	male 0	35	16
9.	84	male 0	32	16
10.	54	male —	34	16
11.	75	male +	35	14
12.	83	male 0	31	16
13.	76	male 0	34	16
14.	77	male +	32	16
15.	77	male +	32	16
16.	77	male +	34	16
17.	70	male 0	31	16
18.	68	male +	32	16
19.	85	male 0	33	16
20.	57	male 0	31	16
21.	56	male 0	29	16
22.	60	male 0	34	16
23.	82	male —	35	16
24.	66	male 0	31	16
25.	71	male +	31	16
26.	67	male 0	29	16
27.	66	male 0	32	16
28.	45	male 0	31	16
29.	74	male —	35	16
30.	81	male +	29	16
31.	71	male +	35	16
32.	67	male 0	32	16
33.	66	male 0	34	16
34.	45	male 0	29	16
35.	74	male —	31	16
36.	81	male +	34	16
37.	71	male +	33	16
38.	82	male —	31	16
39.	60	male 0	33	16

TABLE VII

(Continued)

	TOTAL LENGTH IN MILLIMETERS	SEX	DORSAL FIN RAY COUNT	PECTORAL FIN RAY COUNT
40.	65	male 0	32	16
41.	71	male —	34	16
42.	61	male 0	35	16
43.	65	male 0	32	16
44.	46	male 0	31	16
45.	46	male 0	31	16
46.	56	male 0	34	16
47.	50	male 0	32	16
48.	37	male 0	34	16
49.	41	male 0	32	16
50.	35	male 0	29	16
51.	52	male 0	31	16
52.	104	female	34	16
53.	106	female	34	16
54.	100	female	35	16
55.	97	female	31	16
56.	105	female	33	16
57.	116	female	35	16
58.	97	female	29	16
59.	86	female	31	14
60.	76	female	33	16
61.	95	female	34	16
62.	90	female	31	16
63.	45	female	32	16
64.	95	female	34	16
65.	85	female	32	16
66.	46	female	34	16
67.	73	female	31	16
68.	70	female	34	16
69.	65	female	31	16
70.	58	female	32	16
71.	64	female	29	16
72.	42	female	31	16
73.	36	female	34	16
74.	40	female	35	16
75.	48	female	29	16
76.	64	female	31	16
77.	61	female	33	16
78.	62	female	34	16
79.	59	female	31	16
80.	71	female	33	16
81.	42	female	32	16

+ with eggs in pouch
— empty brood pouch
0 no evident brood pouch

recent population which is not renewed each spring by flood waters from the Tensas River (Plate III, Fig. 1). If this were a very old population, or if it were renewed each spring, more variation should be evident. This population may have been established any time from the present to about 1,000 years ago when the Mississippi River channel crossed the present lake site.

So far as is known, this is the only species of fish in North America known to have breeding populations in both fresh and salt water, with the possible exception of *Mollienesia latipinna* which breeds in fresh and brackish waters. In view of Gunter's (1942) remarks concerning the distribution of *S. scovelli* over the Peninsula of Florida, the discovery of a breeding population in Lake St. John suggests that breeding populations may be present in the fresh waters of Florida which have not been detected as yet.

Editor's Note:

After this article was in page proof, my attention was called to W. M. McLane, (The fishes of the St. John's River System. Doctoral Thesis, University of Florida 1955. *Typescript pp.* 5 + 361.) *in which the author records breeding* Syngnathus scovelli *in the fresh waters of Florida. There are several interesting comparisons between the data of McLane and Whatley, but they cannot be treated here.—G. G.*

The fact that breeding of this pipefish is now known to take place in both fresh and salt water raises some interesting questions concerned with osmoregulation. Even so it should be noted that osmotic problems of the developing eggs are minimized by the fact that transfer of eggs from the female to the male is extremely rapid and the eggs are carried within the brood pouch, where presumably they are maintained in an optimum osmotic environment. This rapid transfer of eggs from the female to the male with a very brief exposure to the surrounding water would seem to explain in part the ability of this fish to breed in both fresh and sea water. In *Mollienesia latipinna* fertilization is internal and the eggs are never exposed.

It is possible, though difficult, to maintain *S. scovelli* in fresh water aquaria, chiefly because a readily available supply of live plankton is essential to their maintenance. Optimum temperature appears to range between 72 F and 80 F. Aquaria should be placed in a shady spot with aquatic vegetation, preferably naiad *(Najas guadalupensis)* placed in the tank.

The metabolic rate of *S. scovelli* is apparently high and a ready supply of plankton permits a very rapid growth of the young from 12 mm up to 80 mm in length. From 27 June 1964 until 7 July 1954, young pipefish maintained in plastic buckets of sea water at the Gulf Coast Research Laboratory increased in length from 12 mm at birth to 28 mm in less than two weeks. From 27 June 1964 until September 1964, three specimens increased their length from 12 mm to 60 mm. This represents a 5-fold increase in length in a period of a little more than three months. Growth slows down at around 80 mm length in both salt water and fresh water forms.

S. scovelli apparently has a life cycle of approximately three years.

There is an apparent difference of trunk to tail ratio in mature males when compared with mature females (Plate IV, Graph 1). Males have comparatively shorter trunks and longer tails with reverse condition being present in females. These differences are not as apparent in juvenile forms.

S. scovelli is gregarious in nature and is normally found in vegetation on the bottom in cooler, more shaded areas. Males with eggs in their brood pouches tend to become solitary or to form groups with other egg-bearing males.

S. scovelli becomes quite seahorse-like in its appearance during mating and both females and males shake their heads violently back and forth in the course of this activity. The actual oviposition is extremely rapid. The incubation period is dependent upon temperature and may vary fram 12 to 18 or more days.

This is the first record in the literature of the breeding behavior of *S. scovelli*. The female is the more aggressive partner in the initial breeding behavior and will oviposit in the male's brood pouch soon after one brood is born. A favorable temperature could mean that the male could incubate 20 or more clusters of eggs yearly in his brood pouch dependent upon an incubation period of 12 to 18 days each time.

Some *S. scovelli* males practiced cannibalism upon their young when kept in containers in the laboratory. This situation may or may not be duplicated in natural conditions.

The range in size of specimens taken from Lake St. John was 18 mm to 160 mm.

Fresh water *S. scovelli* appear to be more robust than their marine counterparts. Marine specimens from Davis Bayou and Horn Island range up to 116 mm in my collection. Fresh water specimens range to 160 mm. Many marine male specimens with eggs in their brood pouches range from 71 mm to 104 mm (Table VII). Fresh water males taken with eggs in their brood pouches ranged from 120 mm to 160 mm.

The answers to the questions posed in the introduction appear to be: (1) this fish is representative of the population designated as *S. scovelli*, (2) this population is strikingly homogenous, (3) a similar population exists in Lake Bruin, Louisiana, (4) this fish can be maintained in fresh water aquaria, (5) this population was probably established in Lake St. John sometime during a period 1,000 years ago until as recently as the 1927 flood, (6) this fish has a life span of approximately three years. The initial rate of growth of *S. scovelli* is extremely rapid.

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